

Remarks

Applicant has filed this Amendment in response to the Office Action dated February 17, 2004. Claims 24, 40, 44 and 60 have been amended. Claims 1-19, 27-31, 57-59 and 62 have been canceled without prejudice. Claims 20-26, 32-56 and 60-61 are currently pending. Reexamination and reconsideration are respectfully requested.

Claims 1-19, 27-31 and 57-59 have been previously canceled without prejudice to further prosecute these claims at a later date. Claim 62 has been canceled without prejudice in this Amendment.

Claims 20-25, were rejected under 35 U.S.C. 103(a) as unpatentable over U.S. Patent No. 6,064,105 to Li et al. ("Li") in view of U.S. Patent No. 6,303,432 to Horita et al. ("Horita") and U.S. Patent No. 6,548,373 to Chuang et al. ("Chuang"). The rejection is respectfully traversed.

To establish a prima facie case of obviousness, there should be a suggestion or motivation in the art to modify the reference or to combine reference teachings, there should be a reasonable expectation of success, and the reference(s) must teach all the claim limitations. MPEP section 706.02(j). Applicant respectfully submits that the Examiner has not met his burden to establish a prima facie case of obviousness.

Regarding independent claim 24, the Examiner stated at page 3 of the Office Action that Li describes "removing the pad layer (114) after the [re]moving the polishing stopper layer (116); forming a sacrificial oxide layer (136) on the first layer (112) after the removing the pad layer (114); . . ." Applicant respectfully submits that the Examiner's statement is not supported by his citation to the art. For example, as described at col. 5, lines 7-10, Li recites that "[t]he thickness of the sacrificial oxide layer is approximately 200A, which is added to the thickness of the barrier oxide layer 114." Thus, the barrier oxide layer 114 still remains when the sacrificial oxide layer 136 is formed. Accordingly, the Examiner's citation to Li does not describe "removing the pad layer after the removing the polishing stopper layer" and "forming a sacrificial oxide layer on the first layer after the removing the pad layer" as recited in claim 24.

The Examiner's comments relating to Horita and Chuang do not appear to overcome the deficiency of Li as described above. Accordingly, for at least the above reasons, applicant respectfully submits that the rejection of claim 24 should be withdrawn.

In addition, for claim 24 the Examiner stated that "Li et al. differ from the claimed invention by not showing implanting impurities to form a well in the first layer adjacent to the trench after the thermally treating the dielectric layer." The Examiner then cited Horita as "forming a well after the thermally treating the dielectric layer," citing Horita at col. 9, lines 9-16. Applicant has reviewed this portion of Horita and not found support for the Examiner's contention. While Horita does appear to describe implanting impurities, the cited portion does not appear to specify thermally treating the dielectric layer prior to the implantation. Thus, the Examiner's citation does not appear to describe or suggest the method recited in claim 24 and the rejection should also be withdrawn for this reason.

For either of the above reasons alone, applicant respectfully submits that the Examiner's citations to the art do not teach all the claim limitations and accordingly, the rejection of claim 24 should be withdrawn.

Applicant also notes that claim 24 was amended to delete the terms "adjacent to the trench" in the last line of the claim. It is believed that this amendment does not narrow the scope of the claim.

Claims 20-23 and 25 depend from claim 24 and the rejection of these claims should be withdrawn for at least the same reasons as claim 24.

In addition, applicant respectfully submits that the Examiner has also not met his burden to establish a suggestion or motivation in the art to modify the reference or to combine the reference teachings as required according to MPEP section 706.02(j). The Examiner stated on page 3 of the Office Action that "it would have been obvious . . . to incorporate the teaching of Horita et al. into the method taught by Li et al. because it eliminates the contamination and recovers the polishing effect." However, the Examiner cited no portion of Li or Horita that describes the elimination of contamination and recovery of the polishing effect due to "forming a well after the thermally treating the dielectric layer." Accordingly, the Examiner has not establish an adequate suggestion or motivation for the proposed combination of references. Thus, the rejection of claim 24 and its dependent claims 20-23 and 25 should also be withdrawn for this reason.

The Examiner also stated on pages 3-4 of the Office Action that "it would have been obvious . . . to incorporate the teaching of Chuang et al. into the method taught by Li et al. and

Horita et al. because it reduces the damage of silicon layer." However, the Examiner cited no portion of the references that describes the reduction of damage to silicon due to thermally treating the dielectric layer. Accordingly, the Examiner has not established an adequate suggestion or motivation for the proposed combination of references. Thus, the rejection of claim 24 and its dependent claims 20-23 and 25 should also be withdrawn for this reason.

The Examiner also stated that for claim 25, "it would have been obvious . . . for thermally treating the dielectric layer is carried out in an atmosphere comprising 0.1 volume % to 10 volume % oxygen because it is densified the dielectric layer." However, the Examiner cited no art for this contention. Moreover, the Examiner also stated that "discovering an optimum value of a result effective variable involves only routine skill in the art." However, in this case the Examiner cited no general conditions from which one could find an optimum value. One cannot discover an optimum value when no general conditions are cited in the art and here the Examiner cited no art having any general conditions relating the oxygen content. Thus, the rejection is claim 25 is deficient and should be also withdrawn for this reason.

Claim 26 was rejected over Li, Horita and Chuang and further in view of U.S. Patent No. 6,165,854 to Wu ("Wu"). The rejection is respectfully traversed. Claim 26 depends from claim 24. The Examiner's citation to Wu does not overcome all of the deficiencies described above relating to the proposed combination of the other references as cited by the Examiner and described above. Accordingly, for at least the above reasons, applicant respectfully requests that the rejection of claim 26 be withdrawn.

Applicant also notes that the Chuang patent may not be prior art against claims 20-26. Applicant notes that Chuang was filed in the U.S. as Application No. 09/821,432 on March 29, 2001, as a CIP of U.S. Application No. 08/397,161, which was filed on Sept. 15, 1999. Applicant's priority application has a filing date in Japan of August 15, 2000.

Claims 32-34 and 38-39 were rejected over Li in view of Horita and further in view of U.S. Patent No. 6,028,339 to Frenette et al. ("Frenette") The rejection is respectfully traversed. Applicant respectfully submits that the Examiner's citations to the art do not describe or suggest a method including "thermally treating the dielectric layer in the trenches at a temperature of at least 1050°C; and after the thermally treating the dielectric layer in the trenches, forming a well region between a first trench and a second trench of the plurality of trenches" as recited in claim

32. The Examiner conceded that Li "differs from the claimed invention by not showing the thermally treating the dielectric layer in the trenches at a temperature about 1050°C." The Examiner cited no additional art for this statement but stated on page 6 of the Office Action that it "would have been obvious . . . for the thermally treating the dielectric layer in the trenches at a temperature about 1050°C, because it is densified the dielectric layer, eliminates the contamination and recovers the polishing defect. Further, it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art." Applicant respectfully submits that the Examiner cited no particular portion of the cited references that supports these statements. One cannot discover an optimum value when no general conditions are cited in the art and here the Examiner's citations to the art appear to include no general conditions relating the temperature or to the order of a thermal treatment and well formation.

Furthermore, the Examiner also stated that "Li et al. differ from the claimed invention by not showing implanting impurities to form a well after the thermally treating the dielectric layer." The Examiner then cited Horita as "forming a well after the thermally treating the dielectric layer," citing Horita at col. 9, lines 9-16. Applicant has reviewed this portion of Horita and not found support for the Examiner's contention. While Horita does appear to describe implanting impurities, the cited portion does not appear to specify thermally treating the dielectric layer. Thus, the Examiner's citation does not appear to describe or suggest the method including "after the thermally treating the dielectric layer in the trenches, forming a well region between a first trench and a second trench of the plurality of trenches" as recited in claim 32.

Accordingly, applicant respectfully submits that the Examiner's citations to the art do not teach all the claim limitations and the rejection of claim 32 should be withdrawn.

In addition, for the same reasons as described above in responding to the rejection of claim 24, the Examiner has not established an adequate suggestion or motivation for the proposed combination of Li and Horita in connection with claim 32.

For either of the above reasons alone, the Examiner has not met his burden to establish a prima facie case of obviousness and the rejection of claim 32 should be withdrawn. Claims 33-34 and 38-39 depend from claim 32 and the rejection of these claims should be withdrawn for at least the same reasons as claim 32.

Claims 35-37 were rejected under 35 U.S.C. 103(a) as unpatentable over Li in view of Horita, Frenette and further in view of U.S. Patent No. 6,165,854 to Wu ("Wu"). The rejection is respectfully traversed. Claims 35-37 depend from claim 34, which depends from claim 32, and the Examiner's citation to Wu does not overcome the deficiencies of the other art as described above for claim 32. In addition, as noted above, the Examiner has not established an adequate suggestion or motivation for the proposed combination of references. Accordingly, for at least the same reasons as claim 32, applicant respectfully requests that the rejection of claims 35-37 be withdrawn.

Claims 40-49, 51-56, and 60-62 were rejected under 35 U.S.C. 103(a) as unpatentable over Li in view of U.S. Patent No. 6,087,243 to Wang ("Wang"). The rejection is respectfully traversed.

The Examiner appears to have cited Wang as relating to thermally treating a trench dielectric layer. The Examiner stated on page 10 of the Office Action that the "combined device shows . . . forming a well in the semiconductor layer after the thermal treatment of the dielectric layer. However, applicant notes that Wang, as cited by the Examiner at col. 6, lines 55-59, appears to describe performing retrograde well implants by ion implantation prior to thermally treating the oxide trench fill. On the other hand, claim 40, as amended, recites in part a method including "implanting impurity ions into the semiconductor layer adjacent to the trenches after the thermal treatment of the dielectric layer." Accordingly, for at least the above reason, the Examiner's citations to the art do not teach all the claim limitations and the rejection of claim 40 and its dependent claims 41-43, 45-49 and 51-56 should be withdrawn.

Claim 44 has been amended for clarity and rewritten in independent form. The Examiner stated on page 11 of the Office Action that the "combined device further shows etching exposes upper surfaces of the semiconductor layer (Li et al., 112)." Applicant respectfully submits that the combined device suggested by the Examiner does not describe or suggest a method including "isotropically etching the pad layer and upper portions of the dielectric layer after the removing the polishing stopper layer and prior to the conducting the thermal treatment, wherein the isotropically etching exposes upper surfaces of the semiconductor layer" as recited in claim 44. The Examiner stated on page 9 of the Office Action that Wang "teaches conducting a thermal treatment of the dielectric layer after removing the polishing stopper layer." However, the

Examiner's citation to Wang appears to describe a method in which the upper surfaces of the dielectric layer are not exposed prior to the conducting the thermal treatment as recited in claim 44. Specifically, Wang at col. 6, lines 53-57, recites that "[s]ilicon nitride layer 13 is then removed leaving a pad oxide layer of about 100Å to 300Å, Retrograde well implants are then formed, as by ion implantation. Heating is then conducted at a first temperature of about 900°C. to about 1100°C. . . ." Thus, it appears that Wang teaches "leaving a pad oxide layer of about 100Å to 300Å," which means that the semiconductor layer is not exposed. Li, as cited by the Examiner, appears to describe a method including similar steps to those of Wang. For example, Li, at col. 4, lines 58-60, recites that "[a]fter the polishing step, the nitride layer 116 is stripped away by etching and a photoresist layer 14 is applied to the top surface of the barrier oxide layer 114 . . ." Thus, the etching at this stage of the Li process does not appear to including exposing the semiconductor upper surfaces as recited in claim 44. Accordingly, the cited art appears to teach away from the process recited in claim 44. As a result, applicant respectfully requests that the rejection of claim 44 and its dependent claims 45-46 be withdrawn for the above reason and for the same reasons as claim 40.

For claim 60, applicant notes that the Examiner's citations to Li and Wang do not describe or suggest a method including "after the heating the dielectric layer to a temperature of at least 1050°C, implanting impurity ions into the semiconductor layer adjacent to the trenches to form a well in the semiconductor substrate adjacent to the trench" as recited in claim 60. Instead, as cited by the Examiner at col. 6, lines 55-59, Wang appears to describe performing retrograde well implants by ion implantation prior to treating the oxide trench fill. Accordingly, for at least the above reason, the rejection of claim 60 and its dependent claim 61 should be withdrawn.

Claim 50 was rejected under 35 U.S.C. 103(a) as unpatentable over Li in view of Wang and further in view of U.S. Patent No. 6,165,854 to Wu ("Wu"). The rejection is respectfully traversed. The Examiner cited no portion of Wu that overcomes the deficiencies of Li and Wang as described above for claim 40, from which claim 50 depends. Accordingly, for at least the same reasons as described above for claim 40, applicant respectfully requests that the rejection of claim 50 be withdrawn.

The Office Action also included various comments concerning the art and the non-patentability of features in various of the pending claims. Applicant notes that the Examiner's

comments in the Office Action that have not been specifically discussed above are deemed moot at this time in view of this response.

Applicant respectfully submits that the pending claims are in patentable form.

Reexamination and reconsideration are respectfully requested. If, for any reason, the application is not in condition for allowance, the Examiner is requested to telephone the undersigned to discuss the steps necessary to place the application into condition for allowance.

Respectfully submitted,

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Dated: May 17, 2004

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Alan S. Raynes May 17, 2004
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